JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1988, 21, 143–156 NUMBER 2 (SUMMER 1988)

INDUCTION AND MAINTENANCE OF SWALLOWING RESPONSES IN INFANTS WITH DYSPHAGIA

NYLA LAMM AND R. DOUGLAS GREER
COLUMBIA UNIVERSITY TEACHERS COLLEGE

A treatment package was used to induce and maintain swallowing with three infants who did not swallow food or liquid. Prior to treatment, they received all nutrition and hydration via gastrostomy tube feedings. The treatment package consisted of least-to-most intrusive physical prompts, an eliciting stimulus, contingent social reinforcement, and repeated trials to induce and maintain swallowing. The design combined elements of reversal and changing criterion designs for all three infants. The package was applied across feeding devices (nipple, cup, spoon), situations (liquid, pureed foods), and persons (trainer, primary nurses, mothers). The number of swallows or ounces per feeding (from 0 to 8 ounces) and the number of feeding sessions per day (from one to five) were progressively increased. In each case, the infant received baseline conditions alternated with the treatment package. Follow-up probes were done at 15 months, 21 months, or 24 months, respectively, after the last phase for the three patients. The package was successful in that the gastrostomy tube was no longer needed for Patients 1 and 3. Patient 2 maintained functional swallowing responses but received supplemental gastrostomy feedings because of unrelated medical problems. Results are discussed in terms of the need to isolate components of the package. The package can be used in cases in which the preexisting treatments (reinforcement with preferred foods, force-feeding) are not feasible because of age, physical fragility, or the lack of a swallowing response following the presentation of food.

DESCRIPTORS: infants, dysphagia, swallowing, food refusal, behavioral medicine

Dysphagia is the inability to swallow or difficulty in swallowing. Its occurrence is associated with disease, accident, physiological malformation at birth, or conditioning (Logemann, 1983). In the latter case swallowing disorders are traced to reports of the pairing of aversive events with swallowing. The impairment may be mild or in some cases severe enough to threaten life. Donner (1986) reports that incidences of dysphagia may be as high as 40% in nursing homes. Swallowing disorders were found to be as high as 12% to 13% in a 3-week period at two major teaching hospitals. Although the condition is most common among the elderly, it also occurs in infants (Fischer, Painter, & Milmoe, 1981) and the developmentally disabled (Riordan, Iwata, Finney, Wohl, & Stanley, 1984).

There is a scarcity of evidence concerning the effective treatment of swallowing dysfunction in children. There is no literature testing the effects of behavioral procedures on dysphagia in children less than 18 months of age who have multiple congenital anomalies (e.g., esophageal fistula) and gastroenterological dysfunctions prior to corrective surgery. The purpose of the studies reported herein was to test the application of a behavioral treatment package to induce and maintain normal swallowing in children fed through artificial means who had not been known to swallow food prior to intervention. The use of force-feeding or preferred food reinforcers was contraindicated because of aspiration problems with infants and because the children did not swallow food or liquids.

Behavioral treatment packages that differ from those used in the present study have been found to be successful with dysphagia (Carstens, 1982; Di Scippio & Kaslon, 1982; Greer & Asnes, 1985; Kaplan & Evans, 1978; Riordan et al., 1984; Solyom & Sookman, 1980; Winstein, 1983). Di Scippio, Kaslon, and Ruben (1978) reported on case studies involving 2- to 3-year-old children who refused to eat solids but could swallow. They reported that the children were successfully "weaned" from the gastrostomy tube by introducing small

Reprints are available from the second author at Box 76, Teachers College, Columbia University, New York, New York 10027. The research reported herein was from a dissertation by the first author under the sponsorship of the second author.

bits of food and progressively increasing the size of the bits of food.

Greer and Asnes (1985) found that a sibling model package was successful in inducing and maintaining oral ingestion of food and liquid by an 18-month-old boy who had no history of swallowing and for whom other procedures had proven unsuccessful. A multiple baseline across solids and liquids determined that the induction of swallowing was a function of the boy's observing the disappearance of food in an older sibling model's mouth. This procedure, although done with a child under 2 years old, differed markedly from the procedures reported herein. The use of the modeling procedure was not feasible with the infants although the inability of the children to swallow was similar to the problem of the child reported in Greer and Asnes (1985).

Riordan et al. (1984) increased the oral food consumption of four handicapped children who refused food or expelled food frequently. Effective treatments consisted of preferred food reinforcement procedures or force-feeding to increase the quantity of food eaten by children with swallowing repertoires. That is, all of these children did swallow, and the problem was one of amount. Similar procedures with dysphagia were reported to be effective by Handen, Mandell, and Russo (1986). Solyom and Sookman (1980) reported that a treatment package (consisting of aversion relief, systematic desensitization, modified flooding, cognitive rehersal, and anxiety management) was successful for four patients ranging in age from 21 to 75 years.

The behavioral treatment package used in this study was designed for infants for whom force-feeding, preferred food reinforcement, peer modeling, or any of the other procedures reported in the literature were not feasible. The procedures were nonaversive, were not life threatening, and were used with infants who had no history of swallowing.

METHOD

Patients

Three patients were selected by the researchers and physicians because they did not swallow foods, received nutrition and hydration via gastrostomy tubes, and had difficulty gaining weight. Force-feeding was contraindicated (as being life threatening), and the other procedures reported in the literature were not feasible.

Patient 1. The first patient was a 13-month-old female inpatient in a suburban tertiary care facility. She had neither sucked nor swallowed since birth, did not drool, and would not permit objects to enter her mouth. She was born at 35 weeks gestational age, was diagnosed as having feeding problems, showed failure to grow, and remained in the Neonatal Intensive Care Unit (NICU) for the first 7 months of life. Because of anatomical abnormalities, she was unable to consume food orally at birth and was fed through a gastrostomy tube. After surgical corrections were performed, she would not swallow even though a videofluoroscopic examination indicated she was capable of doing so.

Her daily gastrostomy feedings consisted of 6 ounces of formula, six times per day. Throughout treatment her oral consumption ranged from 0 to 13 ounces of pureed foods and/or liquids for each session, and gastrostomy feedings were given only as supplements to her total daily intake.

She did not make eye contact, had no social smile, was withdrawn, cried when physically approached or touched, and repeatedly rocked her body. Several tests (Denver Developmental Screening Test, Receptive Expressive Emergent Language Scale, The Portage Guide to Early Education, the Behavior Rating Instrument for Autistic and Other Atypical Children) showed significant developmental delays compared to norms.

Patient 2. The second patient was a 12-month-old male outpatient from a metropolitan tertiary care facility who had a gastrostomy tube inserted because of severe reflux during the perinatal period. He remained in the NICU for the first 6 months of life. He was born full term, diagnosed as failure to grow, and had multiple congenital anomalies that were the result of Ivemarks Syndrome. He remained in precarious medical condition throughout the study and at the follow-up observations. Patient 2 required surgery to correct severe reflux (Nissan Fundoplication was performed).

He was transferred to a tertiary care facility per his parents' request that he be trained to eat orally. Because of the existence of severe episodes of regurgitation of gastrotube feedings, the patient was placed on Reglan, to which he responded and vomiting subsided. Throughout the study this patient received Phenobarbital (2.5 cc) for seizure control, Digoxin (15 cc) and Lassix (0.5 cc) for cardiac treatment, and pencillin for infections.

The patient was severely multiply handicapped (orthopedically, neurologically, and health impaired) and had significant developmental delays in all areas (standardized test results were the same as described for Patient 1). He functioned between 1 to 6 months in all skill levels. He avoided touch to the mouth and face, but would accept a pacifier into his mouth without sucking. The videofluoroscope showed a normal swallowing mechanism with no esophageal peristalsis, and normal functioning of the Fundoplication after the surgical correction. Nevertheless, he did not swallow prior to treatment.

Patient 3. The third patient was a 10-month-old male with Vater Syndrome who was born 2 months premature. He was diagnosed as having feeding problems and growth delay, and remained in the NICU for the first 7 months of life. He was fitted with a gastrostomy tube because of anatomical abnormalities that prohibited oral consumption. After surgical corrections were performed, he still did not swallow in spite of evidence from the videofluoroscope that the appropriate mechanisms were intact.

He was developmentally delayed in all skill areas as shown by all of the standardized tests used with Patients 1 and 2. Patient 3 differed from Patients 1 and 2 in that he emitted a severe tongue thrust. The patient drooled when presented with food, and held his mouth open and tongue retracted with the tip curled back and touching the soft palate. When the tongue was lightly touched, its position changed to lie flat momentarily in the mouth, slightly extending over the lower gum. When a small bolus (amount of food) was placed on the posterior portion, the patient immediately thrust his tongue ½ to 1 inch past the lips, and liquids and pureed foods slid past the pharynx into the esophagus in an uncontrolled manner, and the tongue remained extended. However, this did not constitute a true swallow. Thicker pureed foods initiated a gag and regurgitation of the food.

Settings

Patient 1. This infant received treatment initially in a tertiary care facility (Sessions 1 to 6), in her home placement (Sessions 7 to 15) after discharge from the tertiary care facility, and at readmission in the same hospital (Sessions 16 to 94). The follow-up sessions were conducted in the home and at a restaurant. Inpatient treatment occurred in the patient's private room on the pediatric unit of the hospital. The room had a crib, rocking chair, portable feeding tray, and a sink with a mirror over it. There was also a large window with colorful animals on the curtains, a large window sill, and a view of the pedestrians and traffic entering and exiting the hospital. Treatment occurred at home at the kitchen table.

Patient 2. Patient 2 received treatment both in a tertiary care facility (Sessions 6 to 22) and at home (Sessions 1 to 5 and 23 to 26). The settings for the hospital and home were the same as those described for Patient 1.

Patient 3. This patient received treatment only at home. The home setting was the same as described for Patient 1.

Feeding Utensils and Foods

The materials consisted of a premi nipple, premi bottle, training cup, rubber-coated baby spoon, water, formula, and strained baby foods.

Response Definitions and Data Collection Procedures

The dependent variables for all three patients included the number of swallows, oral intake (ounces of liquid and puree), and body weight. A swallow was defined for observational purposes as the disappearance of a small quantity of food (bolus) placed in the child's mouth only when the disappearance occurred in conjunction with the upward movement of the thyroid cartilage, a swallowing

sound, or both. Each occurrence and nonoccurrence of a swallow was recorded. Videofluoroscopic tapes were made after treatment; the overt behavioral definition of swallowing was consistent in all cases with the videofluoroscopic observation of a true physiological swallow (the passing of a bolus from the mouth with arched tongue, to pharynx, through the esophagus, into the stomach). Weighings were conducted initially by NICU medical staff on the pediatric inpatient unit and in the pediatricians' offices as treatment progressed.

The swallow was observed as occurring or not occurring under independent and prompt conditions (described in swallow training), for each of three feeding implements: (a) premi nipple, (b) training cup, and (c) spoon for liquids and purees. Each occurrence was recorded as a plus (+) and each nonoccurrence was recorded as a minus (−) by independent or prompt categories. Feeding sessions lasted from 10 to 45 min. During baseline, the food was placed in the mouth for 10 trials for each implement and no prompts were used. During treatment, swallows were induced until the child had consumed the quantity determined by the physician.

The trainer and reliability observers both observed opportunities for swallowing responses and each independently measured the quantity of food prior to and after oral feeding sessions. Ounces were measured in graduated medicine cups. The patient's body weight was measured every other day by the nursing staff.

The videofluoroscopic swallowing studies included oral, pharyngeal, and esophageal phases to determine the underlying physiology prior to determination of treatment goals (i.e., to rule out possible aspiration during swallowing, dysfunctional motility that might require different viscosities of food, and occurrences of a lower esophageal ring or a dysfunctional Fundoplication requiring further surgical procedures). Videotapes of swallowing were made of at least one session during treatment to validate the overt observation procedure.

Interobserver Agreement

Independent observations were made by a trained observer in the same room with the patient and trainer and by independent observations of videotaped feeding sessions. For Patient 1, the primary nurses were the second and third feeders. They were taught the methods of the feeding program, were given a copy of the feeding program, and observed a videotaped feeding session. Before serving as reliability observers, the second and third feeders were required to achieve observer agreement of 80% or higher with the trainer. Reliability observations were conducted for 23% of the sessions for Patient 1. The second and third feeders performed interobserver agreement checks at each phase of the study. For Patients 2 and 3, their mothers and primary nurses were trained using the same procedures as described for Patient 1. For Patients 1 and 2 the interobserver agreement of occurrences plus nonoccurrences of swallowing was computed. Occurrences and nonoccurrences of true swallowing were computed separately for Patient 3. Reliability observations were conducted for 33% of the sessions for Patients 2 and 3. An agreement of an occurrence was counted when both observers noted a plus on the scoring form. An agreement of a nonoccurrence was noted when both observers noted a minus for an opportunity to swallow.

For Patient 1 the means and ranges of agreement (agreement of occurrences plus nonoccurrences divided by agreement plus disagreement of occurrences and nonoccurrences multiplied by 100) for successive phases (see Figure 1) were 100%, 90% (85%–100%), 100%, 100%, 100%, 100%, 95% (90%–100%), and 90% (80%–100%). For Patient 2 the means and ranges for successive phases were 100%, 100%, 100%, 100%, 80% (50%–90%), and 80% (0%–90%). For Patient 3, the agreements for occurrence by successive phases were 100%, 50% (0%–100%), 100%, 100%, 80% (50%–90%), and 100%. For Patient 3, the agreement for nonoccurrences by successive phases were 100%, 90% (0%–90%), 100%, 100%, 80% (0%–90%), and 100%. The phases containing low percentages of agreement occurred for Patient 2 during the two phases when the mother was doing the feeding and collecting data simultaneously. The mother's agreement was high during phases in which she did not feed but served as the reliability observer only. A similar problem occurred with the mother of Patient

3 during her training phase. Also, this mother had one session of low reliability during the first treatment phase. However, during this phase the responses ranged only from 1 to 33. Patient 3 also would allow the food to slide down the back of the throat without a true swallow. The mother was counting the disappearance of food only and not looking or listening for the thyroid cartilage movement or sound of swallowing conjointly with the disappearance of food. Nevertheless, the agreement, with the exceptions noted, was high.

Swallow Training

The treatment consisted of four levels of instructional assistance from independent, to verbal prompt, to verbal with partial physical prompt, to verbal prompt with an eliciting stimulus. The physical cue progressed from least-to-most intrusive and consisted of lightly touching the patient's lips, then lower gum, then right posterior portion of the tongue. Touching the right posterior portion of the tongue functioned to elicit the swallow. A 3-s interresponse period followed each prompt. Physical cues were faded on successive trials in response to the patient's acquisition of appropriate approximations to swallowing. Verbal cues consisted of "eat" and "swallow" after 3-s intervals. Occurrences and nonoccurrences of swallows were immediately recorded on the scoring sheet according to the prompt levels for which the response occurred or did not occur.

For Patient 1, a nipple suck was not attained but swallows of liquid placed on the tongue occurred under total prompts (all prompt levels followed by eliciting stimulus) during the first treatment phase. She was shifted to a cup at Session 6 and was swallowing independently with the cup by Session 12. The spoon was introduced at Session 10 with total prompts, and all prompts were removed by Session 52. For Patient 2, the spoon was initially trained and required total prompts for the first six treatments. During the next four sessions, the total prompts were gradually replaced by partial prompts (lip or gum prompts) until by Session 11, 134 of 135 trials were independent (one lip prompt required). The cup was introduced in Session 10 and most prompts removed by Session 15 (102 independent, 34 partial physical prompts). Patient 3 was trained with the spoon first and was independent by the 26th session. The swallow generalized to the premi nipple without training on the 27th session. Cup training was begun on the 24th session, and the child swallowed independently by the 39th session. Ten baseline trials were conducted with each untrained implement during training sessions until all implements were trained or when, in the case of Patient 1, the nipple proved superfluous when cup swallowing occurred and sucking was not attained.

In all cases, the use of the last level of prompt (the trainer's little finger raked lightly and quickly across the posterior portion of the children's tongues) elicited arching of the tongue and resulted in a swallow. After this first occurrence, obtaining the swallow gradually required less and less intrusive prompting.

Treatment sessions ranged from one to five daily. Gastrostomy supplements or feedings did not occur until at least 30 min after feedings. No oral feedings followed gastrostomy feedings. When the patient acquired and maintained ideal quantity (as determined by the physician and dietician) for three consecutive feedings, a 72-hr intensive repeated practice regime was instituted so that the patient could receive total daily nutrition and hydration solely through oral ingestion. A written discussion of the feeding program with a detailed description of the data collection and protocol for visual display was placed in the patient's medical chart and shared with the primary nurses and physicians.

Experimental Design and Treatment Package

A withdrawal design was used to test the effect of the treatment package on swallows and ounces consumed (dependent variables). The design consisted of trainer baseline phases and mother baseline probes alternated with treatment package phases, with 15-month or 2-year follow-up probes. The treatment package or independent variable consisted of graduated prompts and an eliciting stimulus (least to most intrusive), verbal and nonverbal approval of swallows, and repeated training trials. For each child, the treatment package was intro-

duced also in a multiple baseline fashion across feeding implements (premi nipple, spoon, cup). However, for brevity's sake, only the withdrawal design is presented (the multiple baseline component is available from the second author). In two patients no response generalization to baseline implements occurred, and in one patient generalization to the premi nipple did occur.

Each patient had variations of the withdrawal design. The variations occurred because of differences in acquisition rates or the eagerness of mothers to attempt to feed the child when they saw success being achieved by the trainer. In addition, the greater number of alterations produced within-subject replications, thereby providing more within-subject tests of the treatment package. The specific designs for each patient were as follows.

Patient 1 received an initial baseline conducted by the trainer followed by institution of the training package for 6 days. The mother alone baseline occurred for 2 days, followed by a return to the treatment package for 7 days. Subsequently the mother alone baseline was instituted for 4 days, followed by 2 days of baseline conducted by the trainer. Two days of the treatment package occurred followed by 5 days of baseline. The next phase consisted of 27 days of the treatment package. The final phase consisted of the intensive treatment and training of nurses and the mother across several months. A 2-year follow-up probe was conducted by the trainer with the mother alone as the feeder.

Patient 2 received an initial baseline of 4 days followed by introduction of the treatment package and intensive treatments. A 2-day return to baseline followed. The intensive treatment package was reintroduced for 23 days followed by a phase for training the mother. The final phase consisted of the mother alone and a 15-month follow-up probe.

Patient 3 had the greatest number of phase alterations. They consisted of initial baseline (4 days), treatment package (6 days), Baseline 2 (4 days), Treatment Package 2 (10 days), intensive treatment (2 days), mother alone baseline (2 days), Treatment Package 3 (7 days), mother alone baseline (4 days), Treatment Package 4 (17 days), intensive treatment package (2 days), Treatment Package 5 (2 days), mother alone baseline (3 days), Treatment Package 6 (6 days), train mother (10 days), and Treatment Package 7 (11 days); changing criterion and training alone was the final phase which continued for several months. Follow-up data were collected 21 months after the treatment.

Baselines. An initial baseline for each feeding device (premi nipple, drinking from a cup, or eating from a spoon) was conducted using a discrete trial format. Each trial consisted of an opportunity to respond to food presented via one of the three implements (premi nipple, spoon, cup). There were 10 trials for each implement. If the child did not take the food or drink and swallow it on presentation, the trainer placed a small amount of liquid or pureed food on the anterior portion of the tongue and observed the occurrence or nonoccurrence of swallowing. Intertrial response periods were 3 s for each level of response opportunity for each trial. There were 10 trials for each food device for each feeding session or a total of 30 trials per feeding session during baselines. The untrained implements continued to receive baseline trials during treatment as described in the design and swallow training sections.

Treatment package. The treatment package was introduced following the initial baseline with the premi nipple. Baseline trials (10 each) were continued for the other two food implements at each session. After the bolus was placed on the tongue, the least-to-most intrusive prompting procedure consisted of the trainer presenting the food or drink with the verbal prompt "eat" or "drink." This was followed by a 3-s intertrial response period (the trainer counted 1-2-3 aloud). The first physical prompt consisted of the trainer running her little finger lightly over the child's lips. There followed another 3-s intertrial response period. If swallowing did not occur, the trainer ran her finger lightly across the gum of the patient. After another 3-s intertrial period in which the patient did not swallow, the trainer raked her finger lightly across the posterior left quadrant of the tongue. This last trainer prompt served to elicit a swallowing reflex in all cases. The completion of a true swallow by the child then resulted in approval in the form of hugs, praise,

and attention from the trainer. The positions in which the children were held during the feeding sessions changed gradually from total lap positioning to sitting independently as the child acquired greater skill.

After 3 consecutive days in which the child met the amount criteria for training session meals, a new criterion was set (e.g., 2 ounces). Variations in liquids were gradually introduced (water, milk, juices) as were variations in fruits, vegetables, and meats in differing consistencies and viscosities.

Nurse/mother alone baseline. This phase consisted of the mother or nurse feeding or attempting to feed the child before the nurse or mother had received training in the application of the treatment package. The nurse or mother presented the child with at least 30 trials, 10 each with the various feeding implements for each session during this phase.

For Patients 2 and 3, the intensive intervention involved mothers only. For Patient 1, both nurses and the mother alone were involved in the intensive treatment. Some of the slight variability in the intensive treatment phase may have been due to who was performing the intervention. However, no systematic rotation between nurses and mothers was done. Some differences in the interobserver agreement between nurses and mothers are described under *Interobserver Agreement.*

Intensive treatment package. The first day of this phase consisted of rapidly changing criteria and repeated trials with the treatment package until the patient had consumed orally half of his or her physician's recommended daily intake (e.g., 17 of 33 ounces). Supplemental gastrotube feedings were given while the patient was asleep at night. On Day 2, the oral consumption was increased to two thirds of the recommended daily intake. On Day 3, all consumption was accomplished orally with the treatment package in four feeding sessions. No food was introduced via gastrostomy tube.

After three additional and consecutive days of oral consumption alone, the nurse or mother was trained to implement the treatment package and collect data.

Training nurse/mother phase. The training for the nurse or mother consisted of the following procedures and stages. In Session 1, the nurse or mother observed a videotape of the trainer feeding the child, supplemented by the trainer's verbal instructions. The second training stage consisted of the nurse or mother observing the trainer feed the child orally for four consecutive meals. For the third training stage, the nurse or mother fed the patient for one feeding session and received verbal approval from the trainer for correct responses. The trainer prompted the nurse or mother and participated in patient reinforcement. Incorrect responses by the nurse or mother were verbally or physically corrected. For the fourth training stage, the mother or nurse fed the child for two meals under the trainer's tutelage. For the fifth stage, the mother or nurse fed the child three of the four daily meals and for the sixth stage all four meals. After 3 consecutive days of feeding the child all four meals in which the child consumed all nutrition orally, the nurse or mother began the posttraining nurse/mother alone phase.

Nurse/mother alone phase. This phase consisted of the nurse or mother feeding the child without receiving correction from the trainer, who initially sat at a distance from and out of eyesight of the patient and the feeders. Subsequently, the nurse or mother collected the data and reported to the trainer, but the trainer was not present at the sessions except to conduct reliability observations.

RESULTS

The data for swallows and ounces consumed for each of the three patients are shown in Figures 1, 2, and 3, respectively. The data points for swallowing are the means for feeding sessions across 2-day periods. The means were derived by dividing the total swallows over 2-day periods by the number of oral feeding sessions in the 2-day periods. The means for ounces were daily means and were derived by dividing the total ounces consumed orally for 2 days by two. Occasionally single-day means were computed because the occurrence of an interruption in treatment resulted in an odd number of days. Means were appropriate for swallows be-

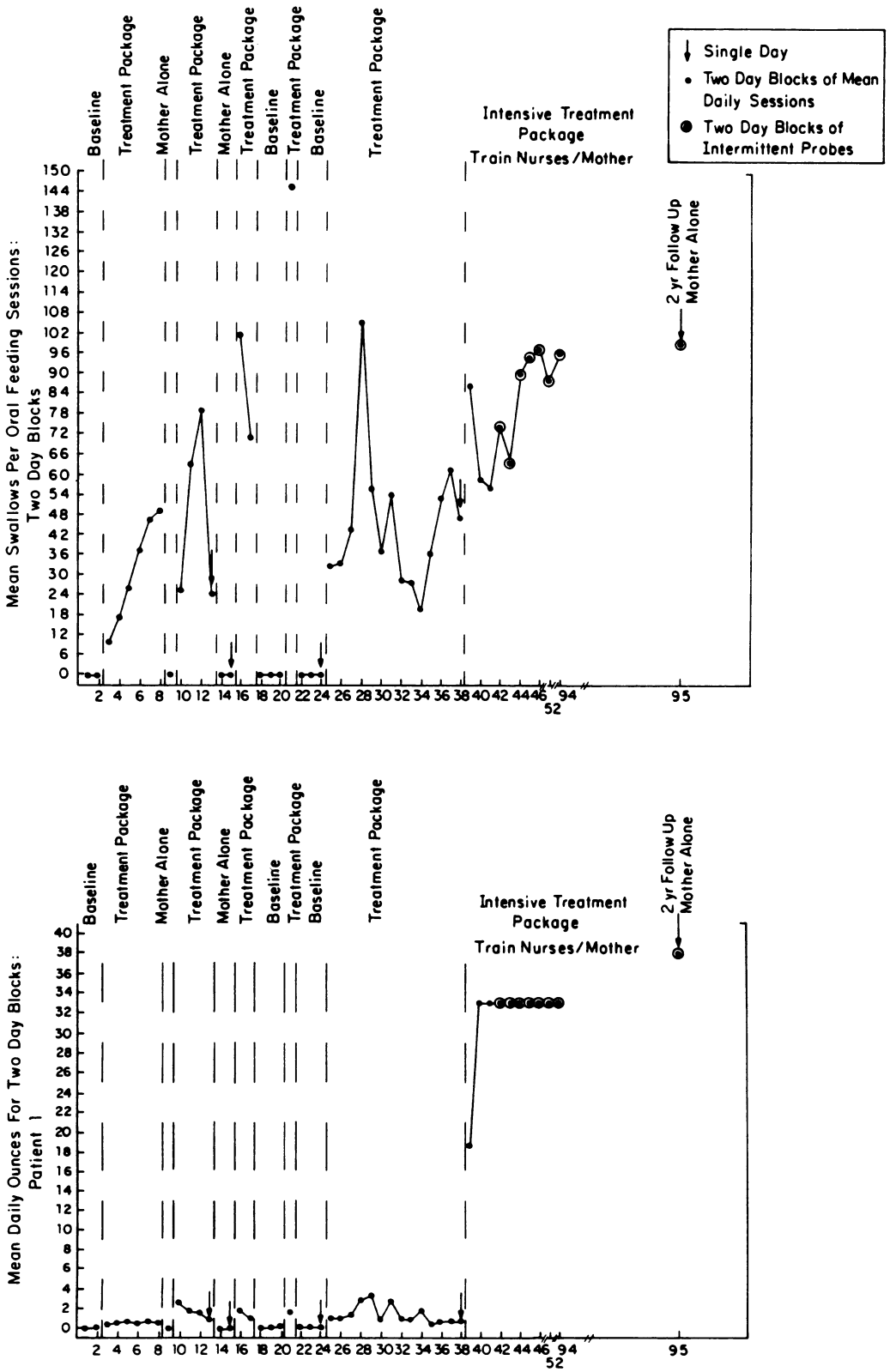

Figure 1. Mean swallows for oral feeding sessions and mean ounces consumed per day for 2-day blocks, Patient 1.

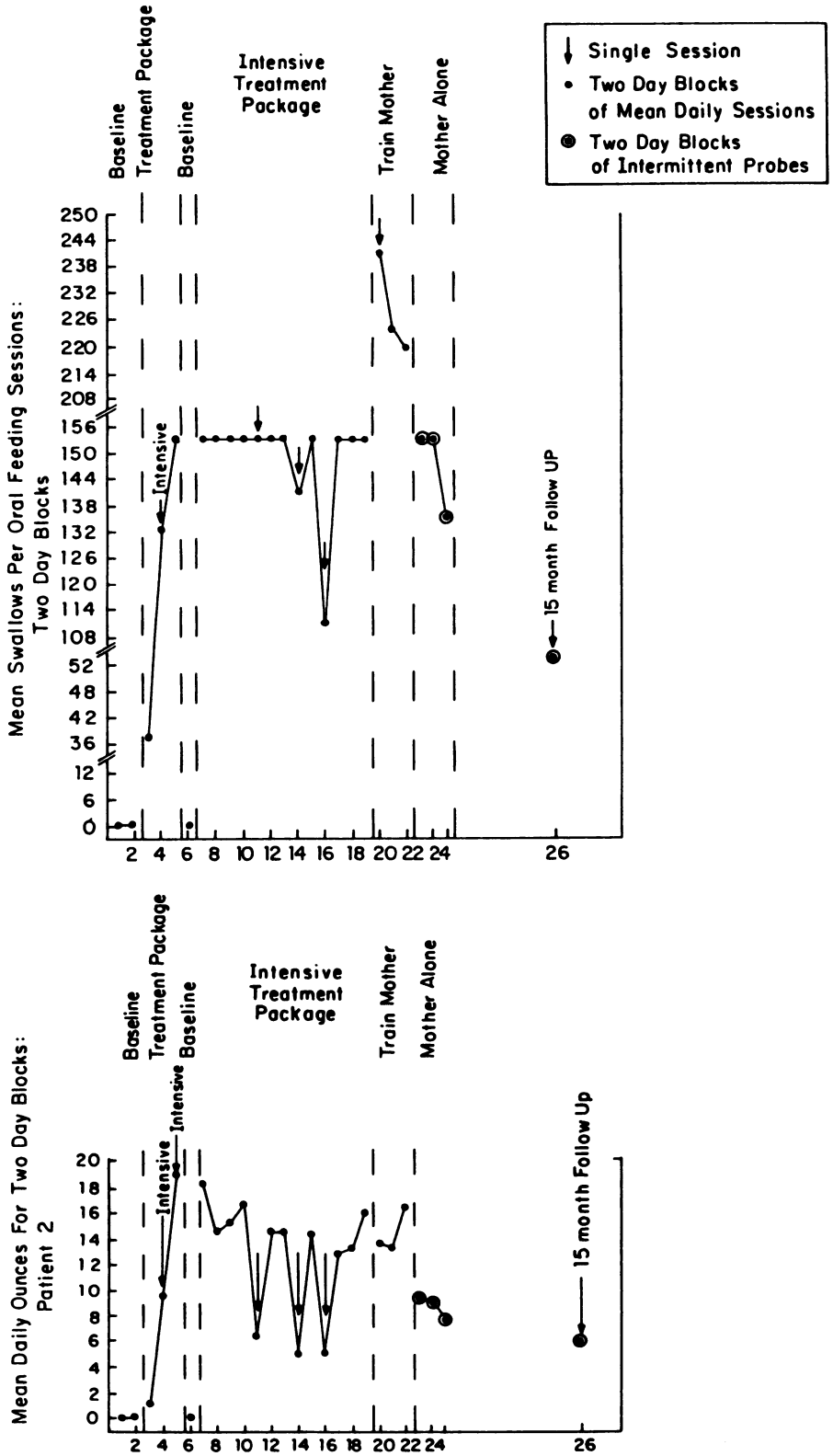

Figure 2. Mean swallows for oral feeding sessions and mean ounces consumed per day for 2-day blocks, Patient 2.

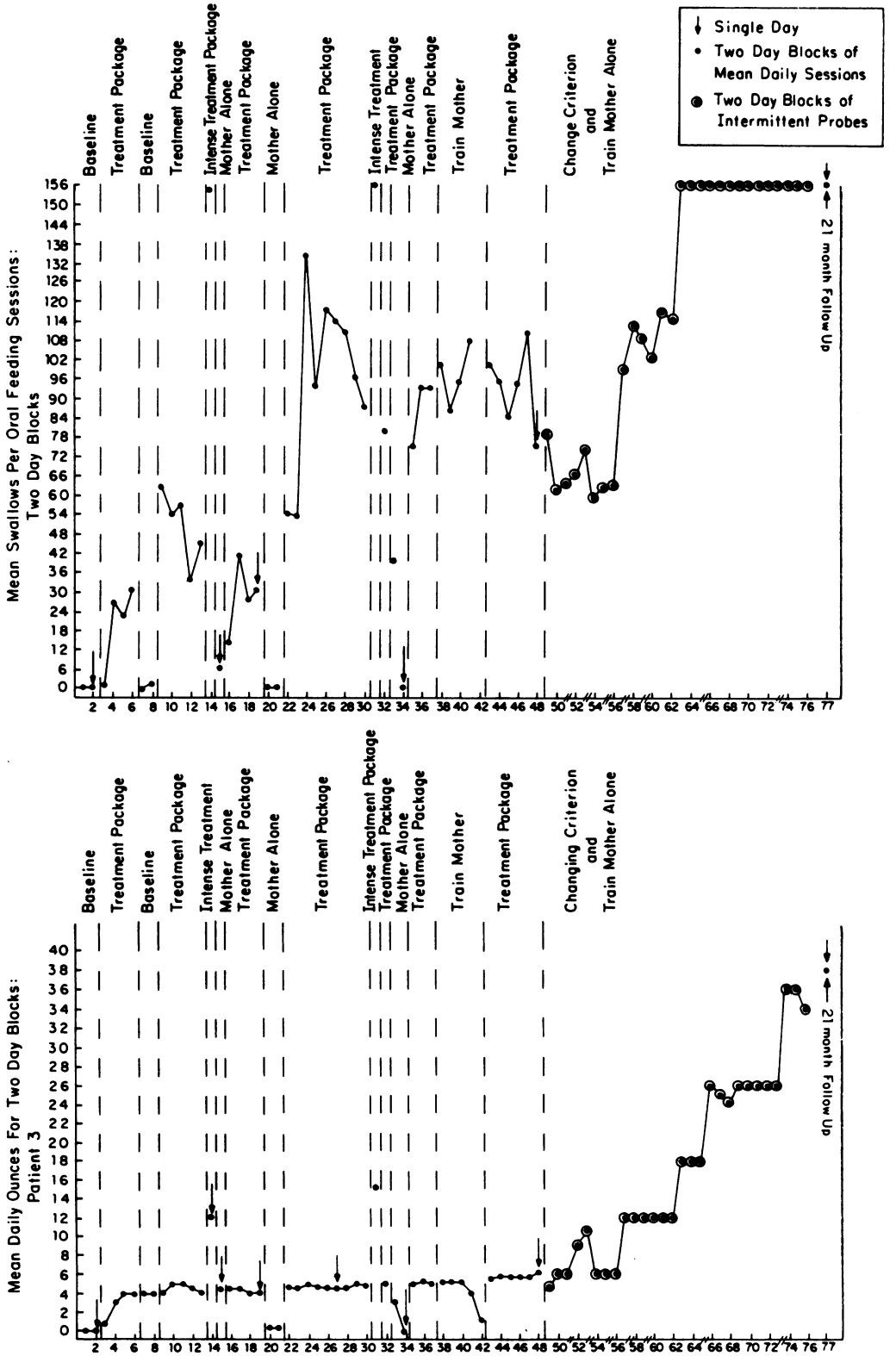

Figure 3. Mean swallows for oral feeding sessions and mean ounces consumed per day for 2-day blocks, Patient 3.

cause the number of feeding sessions per day varied from one to four sessions, except during the intensive package phases in which four sessions were conducted daily. Means for total ounces across 2 days were representative of daily totals. Until each child consumed all nutrition orally, daily oral intake was supplemented via gastrostomy feedings. The amount supplemented was the total consumption recommended minus oral consumption and was given at least 30 min after the oral training.

Patient 1

During the first baseline of 4 days, the patient took no foods or liquids orally, nor were there any reports of the patient consuming nutrition orally. During the first treatment phase the mean number of swallows was 32 (range, 10 to 49). Figure 1 shows that swallows increased steeply but the phase mean for ounces was only 0.46 ounces (range, 0.20 to 0.80). Swallows and consumption returned to zero levels during the first mother alone baseline. A return to the treatment package (7 days) resulted in an increase in swallows to a phase mean of 47 (range, 24 to 79) and ounces to a phase mean of 1.62 (range, 0.4 to 2.5). During the second mother alone baseline, swallows and consumption were again zero. The treatment was again instituted for 4 days with a phase mean for swallows of 85 (range, 70 to 101) and a phase mean for daily ounces of 1.25 (range, 0.80 to 1.7). During the second baseline conducted by the trainer (6 days) the means for swallows and consumption were again zero. During the fourth treatment phase (a single day) the mean for swallows was 145 and 3 ounces were consumed. In Baseline 3, the means were again zero. During the fifth treatment phase (27 days) the mean for swallows was 44 (range, 19 to 105) and for ounces 1.32 (range, 0.3 to 3.2). For the intensive treatment phase the mean for swallows was 83 (range, 55 to 97) and the mean for ounces was 30.88 (range, 18 to 33), well within normal nutritional expectation. At the 2-year follow-up the means for swallows and ounces were 99 and 38, respectively. Swallows and ounces did not always correlate, because in the later stages of treatment swallows resulted in greater consumption.

Patient 1 was unable to acquire functional sucking behavior in relation to drinking from a nipple during treatment. At the 2-year follow-up, this patient did drink from a straw by sucking, and maintained this response while drinking from a cup and eating solid table foods from a spoon. The gastrostomy tube was removed 14 months after treatment began. The patient's weight was 10 lbs prior to the onset of treatment. Fourteen months after treatment had begun she weighed 22 lbs.

Patient 2

During the initial baseline the means for swallows and consumption were zero for Patient 2 (Figure 2). There were no reports of any oral consumption before the baseline. During the first treatment phase the mean for swallows was 106 (range, 37 to 150) and for ounces was 9.8 (range, 1 to 19). Responses and consumption were zero at Baseline 2 (2 days). During the following intensive treatment package of 23 days the mean for swallows was 152 (range, 111 to 155) and the mean for ounces was 12.58 (range, 5 to 18.2). In the mother training phase, the mean for swallows was 231 (range, 210 to 275) and the mean for ounces was 13.4 (range, 13.2 to 13.7). During the final phase (mother alone) the mean for swallows was 145 (range, 136 to 155) and for ounces 8.7 (range, 7.7 to 9.5). At the 15-month follow-up the mean for swallows was 54 and for consumption was 6 ounces.

Patient 2 was unable to continue with the treatment package after 1 month because of the religious observances of his family and the distance from their residence to the hospital. A 15-month follow-up of this patient showed maintenance of functional swallowing and oral intake in ounces; however, performance decreased for his recommended nutritional total daily oral intake (16 to 18 ounces) to a total daily oral intake maintained at 6 ounces. This child received supplemental gastrostomy tube feedings at the 15-month follow-up. The patient's total weight gain during treatment was 1.8 lbs in the relatively short treatment period.

Patient 3

For Patient 3 (Figure 3) baseline swallow and ounce data points were zero and there was no history

Table 1
Summary of Data for All 3 Patients

	Before treatment			After treatment		
	Weight	Oral intake	Artificial intake	Weight	Oral intake	Artificial intake
				14 months of treatment		
Patient 1	10 lbs	None	Hyperalimentation gastrostomy tube fed 100%	22 lbs (12-lb increase)	36 oz.	None
				1 month of treatment		
Patient 2	11 lbs	None	Hyperalimentation gastrostomy tube fed 100%	12.5 lbs (1.8-lb increase)	16.5 oz	7.5 oz GT
				12 months of treatment		
Patient 3	8 lbs	None	Hyperalimentation gastrostomy tube fed 100%	18.8 lbs (10.8-lb increase)	34–36 oz	none

of swallowing. The mean for swallows for the first treatment package was 19 (range, 1 to 33) and the mean for ounces was 2.9 (range, 0.85 to 4). Baseline 2 shows the mean for ounces was 4 and the mean for swallows 1 because the food slid over the extended tongue into the esophagus without the assistance of the child's swallowing mechanism. In the second treatment package the mean for swallows was 50 (range, 33 to 62) and the mean for ounces was 4.5 (range, 4 to 5). The single day of intensive treatment showed the mean for swallows was 149 and the mean for ounces was 12. In the mother alone phase, a single day, the mean for swallows was 6 and the mean for ounces was 4.5 because the food was consumed even though swallowing occurred only six times. That is, the liquid again rolled down the esophagus without swallowing. The third treatment package shows the mean for swallows was 28 (range, 14 to 41) and the mean for ounces was 4.12 (range, 4 to 4.5). In the second mother alone phase, the mean for swallows was zero and the mean for ounces was 0.5. In the fourth treatment package the mean for swallows was 93 (range, 53 to 132) and the mean for ounces was 4.6 (range, 4.65 to 5). The second intensive treatment package (2 days) resulted in a mean of 150 swallows and a mean daily consumption of 15 ounces. The fifth treatment package resulted in means for swallowing and ounces of 77 and 5, respectively. In the third mother alone phase, the means for swallows and ounces were 19 (range, 0 to 40) and 1.5 (range, 0 to 3), respectively. For the sixth treatment package the mean for swallows was 85 (range, 73 to 91) and the mean for ounces was 5 (range, 5 to 5.1). In the training mother phase, the mean for swallows was 77 (range, 10 to 106) and the mean for ounces was 4 (range, 1 to 5). The seventh treatment package resulted in a mean for swallows of 91 (range, 73 to 108) and a mean for ounces of 5.58 (range, 5.2 to 6). In the changing criterion phase (train mother alone and gradually intensify treatment), the range for ounces increased in a stepwise fashion from 4.5 to 36 ounces consistent with changes in criteria.

Eight months after treatment began, this patient was fed all his meals orally by his mother, was independently requesting liquids and table foods, and was independently drinking from a cup and eating table food with his fingers (fruits, boiled ham, spaghetti, cookies, frankfurters). Twenty-one months after the end of the treatment package, the child was orally consuming food at normal levels (greater than 156 swallows and 38 ounces). The gastrostomy tube was not used but had not been removed because the child was scheduled for surgery unrelated to the feeding problem. Retention

Table 1
(*Continued*)

Follow-up
At 2 years
Consumed all table foods (38 oz) independently with cup, spoon, fork. Developmentally age appropriate for all skills.
At 15 months
6 oz oral spoon fed. Severe developmental delays. Health impaired.
At 21 months
All table foods (36–38 oz) independently with cup, spoon, fork. Developmental delays in gross motor and speech/language skills.

of the gastrostomy tube was a precaution only. Patient 3 gained 10.8 lbs in 12 months of treatment. The pretreatment and posttreatment weights and descriptions for each child are shown in Table 1.

DISCUSSION

The data show that the acquisition of swallowing was a result of the treatment package and that mothers or nurses were unable to obtain swallowing responses until they were trained and applied the package correctly. The initial swallows for all three patients were the result of the total physical prompt procedure—a light touch to the posterior portion of the tongue. The light touch served as an eliciting stimulus for a swallow, which was then reinforced. it is not known whether the eliciting stimulus alone would have been sufficient. Future research should isolate which components of the package are essential. Numerous swallows had to be elicited with each patient before less intrusive prompts or the bolus alone became sufficient to elicit swallows. It is possible that the progression from least-to-most intrusive is a necessary process. On the other hand, the eliciting stimulus alone may be all that is required.

The procedure is the least intrusive in the existing literature. Thus, the procedure, although lengthy, is the only one currently feasible for patients for whom asphyxiation is a real danger. It may be difficult if not impossible to use the procedure with individuals who have a full complement of teeth. The procedure thus must be done during the infant stage or adapted for older patients.

The weight gains associated with the treatment are apparently unusual (William Heird, personal communication, March 1987) for children who are switched from gastrostomy tube to oral feeding. That is, after the switch, weight loss usually occurs (Greer & Asnes, 1985), apparently because gastrostomy tube feedings often are higher in caloric content than what children would have consumed orally. However in the present study, Patient 1 gained 12 lbs over the 14-month treatment period, Patient 2 gained 1.8 lbs over 1 month of treatment, and Patient 3 gained 10.81 lbs over 12 months of treatment. The weight gain occurred despite the fact that the ounces consumed were comparable between oral and gastrostomy tube conditions. The role of the esophagus in metabolism requires further study because of the theory that the esophagus contributes to metabolism. Future research like that presented herein may serve to test this theory.

Patient 1, who was initially diagnosed as developmentally delayed, was developmentally age appropriate in all skills at 2 years of age. Patient 3 was able to feed himself table foods and liquid after the treatment and made significant developmental gains. Removal of the tube was accomplished for Patient 1 and was imminent for Patient 3 (who was receiving all nutrition and hydration orally at the follow-up). Patient 2 still suffered from precarious medical conditions, and nutrition and hydration were supplemented by the gastrostomy tube. The parents of all three children expressed satisfaction with the procedure; more importantly, they maintained its use and were active in the use of the treatment.

All three patients had no history of swallowing. This characteristic was similar to that of the child described in Greer and Asnes (1985). Induction of the swallow suggested that the response was present but dormant. Perhaps swallowing normally occurs

in concert with respondent suckling and if suckling does not occur in the normal developmental process, the swallow does not result. The possible relationship between suckling and swallowing calls for further research.

The videofluoroscopic study of swallowing served to validate the overt behavioral definition. It is possible, as in the case of Patient 3, for the bolus or liquid to slide down the esophagus without a swallow. However, at a certain level of consistency or amount, the swallow becomes necessary or a gag results. Thus, the lack of drooling in two of the patients and in the patient reported by Greer and Asnes (1985) may result from saliva sliding down the esophagus without the aid of a swallow.

Although it may not be feasible to isolate the effectiveness of the respondent conditioning procedures from the operant procedures, components of the package may be isolated in future research. The procedures presented in this study suggest new and less intrusive procedures to use in treating infants with dysphagia.

REFERENCES

Carstens, C. (1982). Behavioral treatment of functional dysphagia in a 12-year-old boy. *Psychosomatics,* **23,** 195–196.

Di Scippio, W., & Kaslon, K. (1982). Conditioned dysphagia in cleft palate children after pharyngeal flap surgery. *Psychosomatic Medicine,* **44,** 247–257.

Di Scippio, W., Kaslon, K., & Ruben, R. (1978). Traumatically acquired conditioned dysphagia in children. *Annals of Otology, Rhinology, Laryngology,* **87,** 509–514.

Donner, M. (1986). Editorial. *Dysphagia,* **1,** 1–2.

Fischer, S., Painter, M., & Milmoe, G. (1981). Swallowing disorders in infancy. *Pediatric Clinics of North America,* **28,** 845–854.

Greer, R. D., & Asnes, R. S. (1985). *Use of natural contingencies to induce oral ingestion by a child who was fed by gastrostomy from birth.* Paper presented at the annual convention of the Association for Behavior Analysis, Columbus, OH.

Handen, B. L., Mandell, F., & Russo, D. C. (1986). Feeding induction in children who refuse to eat. *American Journal of Diseases of Children,* **140,** 52–54.

Kaplan, P., & Evans, I. (1978). A case of functional dysphagia treated on the model of fear of fear. *Journal of Behavior Therapy and Experimental Psychiatry,* **9,** 71–72.

Logemann, J. (1983). *Evaluation and treatment of swallowing disorders.* San Diego, CA: College Hill Press.

Riordan, M., Iwata, B., Finney, J., Wohl, M., & Stanley, A. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis,* **17,** 327–341.

Solyom, L., & Sookman, D. (1980). Fear of choking and its treatment. *Canadian Journal of Psychiatry,* **25,** 30–34.

Winstein, C. J. (1983). Neurogenic dysphagia: Frequency progression and outcome in adults following head injury. *Physical Therapy,* **12,** 1992–1997.

Received May 6, 1987
Initial editorial decision July 15, 1987
Revisions received September 25, 1987; January 15, 1988
Final acceptance February 11, 1988
Action Editor, John E. Martin